JAST LOGISTICS MODELING ENVIRONMENT (JLME)

Research and Analysis into the Concept, Structure, Methodology and Application of a Logistics Modeling Environment

31 July 1995

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This Briefing presents the results of a Special study completed by Dynamics Research Corporation in support of the Joint Advanced Strike Technology (JAST) Program Office. The work centered on the conduct of literature searches using the BMD TIC library resources and coordination with government and contractor organizations to identify modeling tools, mode input requirements, and output to help define a possible framework for JAST logistic modeling environment (JLME). Analyses were conducted using data bases and resources to investigate possible methodologies for linking data flow between models within a candidate modeling hierarchy that would include engineering, mission, and campaign level tools. A sample analysis was conducted to demonstrate the functionality of such a JLME envisioned by the JAST Program Office.

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JAST LOGISTICS MODELING ENVIRONMENT (JLME)

Special Study Briefing Report

Submitted To:

BMDO/POI

31 July 1995

In accordance with Contract No. SDIO84-90-C-0002, Task Order No. SS-6, this briefing report presents the results of a special study completed by Dynamics Research Corporation in support of the Joint Advanced Strike Technology (JAST) Program Office. The work centered on the conduct of literature searches using TIC library resources and coordination with government and contractor organizations to identify modeling tools, model input requirements and output to help define a possible framework for a JAST logistic modeling environment (JLME). Analyses were conducted using data bases and resources to investigate possible methodologies for linking data flow between models within a candidate modeling hierarchy that would include engineering, mission, and campaign level tools. A sample analysis was conducted to demonstrate the functionality of such a JLME envisioned by the JAST Program Office.

Overview

- **Present Results of the DRC Effort in Support of the JAST Logistics Modeling Environment (JLME)**
  - **Contract No. SDI084-90-C-0002**
  - **Task Order No. SS-6**

- **Major Areas of Work**
  - **Identify modeling tools, model input requirements, data sources, build input data sets, and investigate methodologies for linking data flow between candidate models**
  - **Evaluate Analytic models as possible resources within a Toolkit to provide integrated engineering, R&M, and cost analyses**
  - **Conduct sample analyses to demonstrate functionality**

The Joint Advanced Strike Technology Program is best described in terms of " A Joint Services Team creating the building blocks for affordable, successful development of next generation strike weapon systems." The current program focus is that of a family of three aircraft each meeting specific, service unique design requirements, yet all sharing a common production line to achieve affordability. The US Navy seeks a survivable strike fighter aircraft to complement the F/A-18E/F, while the US Air Force is planning now for a replacement of the F-16, multi-role aircraft with primary emphasis on the air to ground mission. The US Marine Corps seeks an ASTOVL aircraft to replace the AV-8B and F/A-18.

Background

Joint Advanced Strike Technology Program

VISION

"A Joint Services Team creating the building blocks for affordable, successful development of next generation strike weapon systems."

Meeting Specific Service Needs

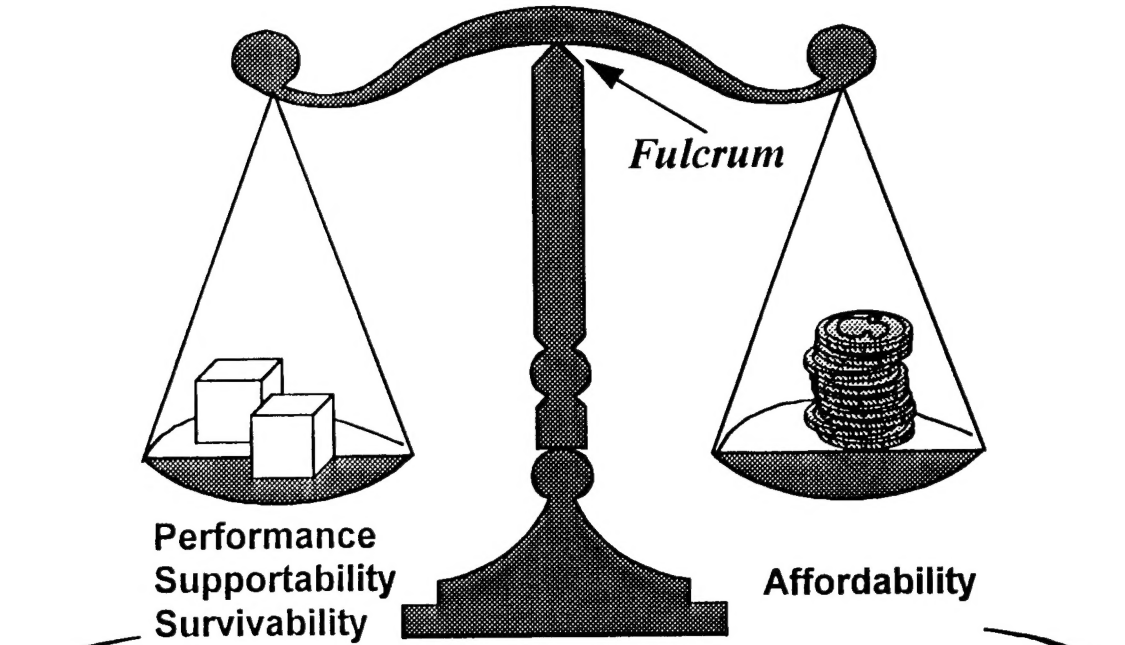
U.S. Navy: *A Survivable Strike Fighter Aircraft to Complement the F/A-18 E/F*

U.S. Air Force: *Multi-role Aircraft (Primary A/G to Replace the F-16)*

U.S. Marine Corps: *ASTOVL Aircraft to Replace the AV-8B*

The planned use of a common production line provides compounding benefits to affordability through both acquisition cost savings associated with economies of scale but also through the concept of maximizing commonality in many areas of system support. As such the JAST Program Office (PO) is firmly committed to reaching a carefully balanced next generation strike aircraft design solution based on a well structured research and development program complemented with comprehensive trade analyses encompassing performance, supportability survivability, and affordability. Performance taken here is meant to include both global factors (i.e. performance as measured at the theater or campaign level) and specific measures at the mission or subsystem level such as sortie generation rate and target acquisition, engagement and lethality. Imbedding support and logistics within the design process has been promoted through the strong leadership provided by the Air Force Support Requirements group within the JAST PO. Therefore, there is no question that the expectation of success in achieving this balanced and optimized design solution will demand a highly effective and flexible logistics modeling environment located at the fulcrum of the balance shown here.

JAST Expectation: Balance Trade Insights



Based on Integrated Trade Analysis Hierarchy

- ***Campaign***
- ***Mission***
- ***Engineering, R&M, Cost***

The basic attributes of this JAST Logistics Modeling Environment (JLME), the fulcrum, would span the list shown here. The conduct of trade-off analyses in reliability, maintainability, supportability and deployability (RMS&D) would be an essential element. It should be noted that the current Phase I work undertaken by DRC is focused on the RM&S portions. The JAST PO, however, has identified the need to incorporate deployability factors into such an environment and has outlined potential Phase II work to examine this area. Trading logistics parameters within the context of campaign and mission scenarios will help define RM&A thresholds for incorporation into the ORD and other acquisition documents. Realistic trades assessing logistic and support strategies within an operational context will also allow the identification of potential support deficiencies, constraints and or shortfalls and will ensure the insertion of logistics factors into wargaming exercises. The ability to explore options and evaluate impacts on cost, mission performance and battle outcomes will play a significant role in system design and finally, a very critical feature would be the traceability across all trade parameters by ensuring use of a consistent set of tools and data flowing between tools. Clearly such a modeling environment would draw from a wide base of candidate tools that would span the range between campaign level engagement simulations, through mission level models of greater fidelity, down to rapidly running analytic engineering models that could address more specific design issues. This represents an area where DRC's research and analysis in support of this study played a major role and in which past work with BMDO offered a significant level of synergy.

JLME - The Fulcrum Needed For "Balanced Solution"

JLME Will Provide the Modeling Environment for the JAST Program Office and its Contractors to:

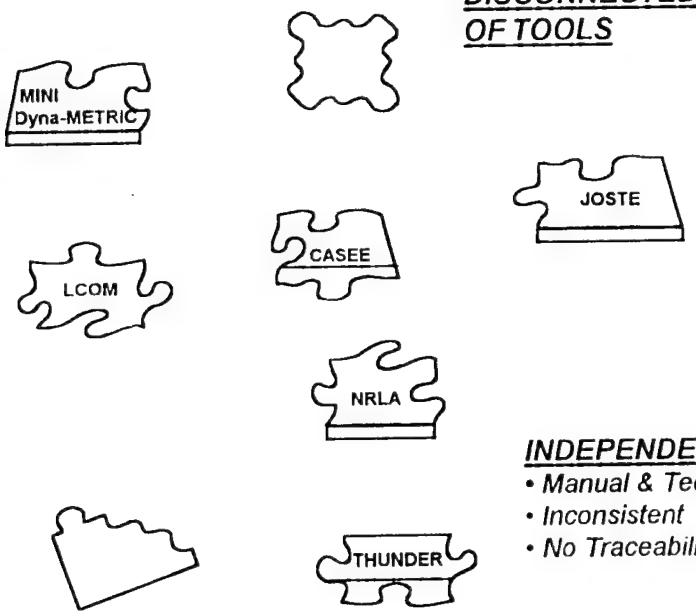
- **Conduct Trade-off Analyses**
- **Develop Logistics Performance Requirements for Acquisition Documents**
- **Identify Logistics Deficiencies, Constraints and Shortfalls**
- **Insert Logistics Influences & Constraints in Wargaming Exercises**
- **Explore Options and Evaluate Impacts on Cost, Mission Performance, and Battle Outcomes**
- **Provide Traceability Between Cost/Affordability/ Supportability, Mission Performance, and Battle Outcomes**

Through literature searches and coordination with the government and weapon system contractors (WSCs), a multitude of simulations and analytic models of relevance to the JAST program were identified. The challenge, however, was to reduce this multitude of resources down to a selected few that would provide the necessary coverage in assessments, offer opportunity for clearly defined integration, efficiency, ease and speed in execution and be an integral part of the WSCs design process working the program. Starting with a resource base in the hundreds the list was reduced quickly to under 80 and through additional assessments and consensus building a final smaller list of six models and simulations were recommended as candidates for the modeling environment. These would fit nicely into a modeling hierarchy as shown and through integration would allow achievement of the many desired functions listed on the previous chart. In addition, however, a level playing field would be established and a consistent modeling environment used by the Program Office to assess competing designs. The contractors endorsed this proposed approach and recognize its utility as a method to achieve consistency and offer a means to validate their own assessments. The contractors, in fact, preferred not to have their own proprietary analytic tools hosted within the proposed Toolkit but to populate the engineering level of the hierarchy with government tools. As such, all tools in the presently conceived JLME are well known government tools with established credibility

From Chaos to Order

Without JLME

DISCONNECTED MULTITUDE OF TOOLS



INDEPENDENT MODELS

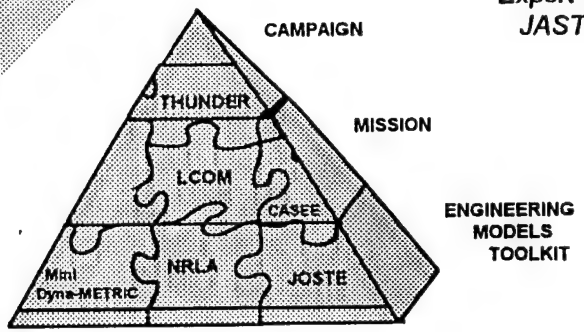
- *Manual & Tedious*
- *Inconsistent*
- *No Traceability*

ISOLATED CAPABILITY ASSESSMENTS

With JLME

JLME GOALS:

- *Integrated Hierarchy of Models*
- *ToolKit*
- *Baseline Data Sets*
- *PC-Based Decision Support System*
- *Export Output to JAST/ASI Spreadsheets*



WILL PROVIDE: LEVEL PLAYING FIELD

- *COORDINATED Simulation Tools*
- *INTEGRATED Analytical Models*
- *AUTOMATED Data Transfer*
- *CONSISTENT Results Reporting*

Brief descriptions of the proposed six member JLME hierarchy of simulations and analytic tools are shown here. The THUNDER code is widely used in strike aircraft campaign level assessments and is the tool of choice within the JAST PO. As will be shown in a sample analysis used to investigate the utility of the JLME, THUNDER identifies availability and logistics shortfalls in terms of canceled missions that are due to aircraft problems. At the mission level both LCOM and CASEE are recommended for inclusion within the environment. LCOM has a long successful history in the USAF and CASEE is an excellent simulation for treating both carrier and land based operations. It is widely used by the Navy. Both tools are Monte Carlo simulations programmed in simscript and GPSS respectively and can identify logistics pacing items at the 5 digit Work Unit Code (WUC). At the engineering level, the analytic tools shown offer speed and flexibility to address operational (e.g. sortie generation rates) as a function of design and support parameters with the capability to address cost impacts. The utility of these within an integrated environment will also be addressed in the sample analysis.

Tool Hierarchy Will Span/ Design to Wargaming

WARGAME/CAMPAIGN LEVEL

- THUNDER - Incorporates Air War, Ground War, Deployment, Re-supply
  - Output identifies availability/logistics shortfalls

MISSION LEVEL

- LCOM - A.F. Land Based; Sortie Generation Levels vs Logistic Mixes
  - Identifies logistics pacing items at 5 digit Work Unit Code (WUC)
- CASEE - Navy Carrier Based; Relates Operational Readiness to R&M
  - Aircraft defined to 5 digit WUC

ENGINEERING LEVEL

- Mini Dyna-METRIC - Engineering Level Sortie Rate vs Logistics Support System
- NRLA - Repair Level Analysis (intermediate, depot, discard) vs Cost
- JOSTE- AF, Navy, Marine; O&S Cost Impact of New Technology

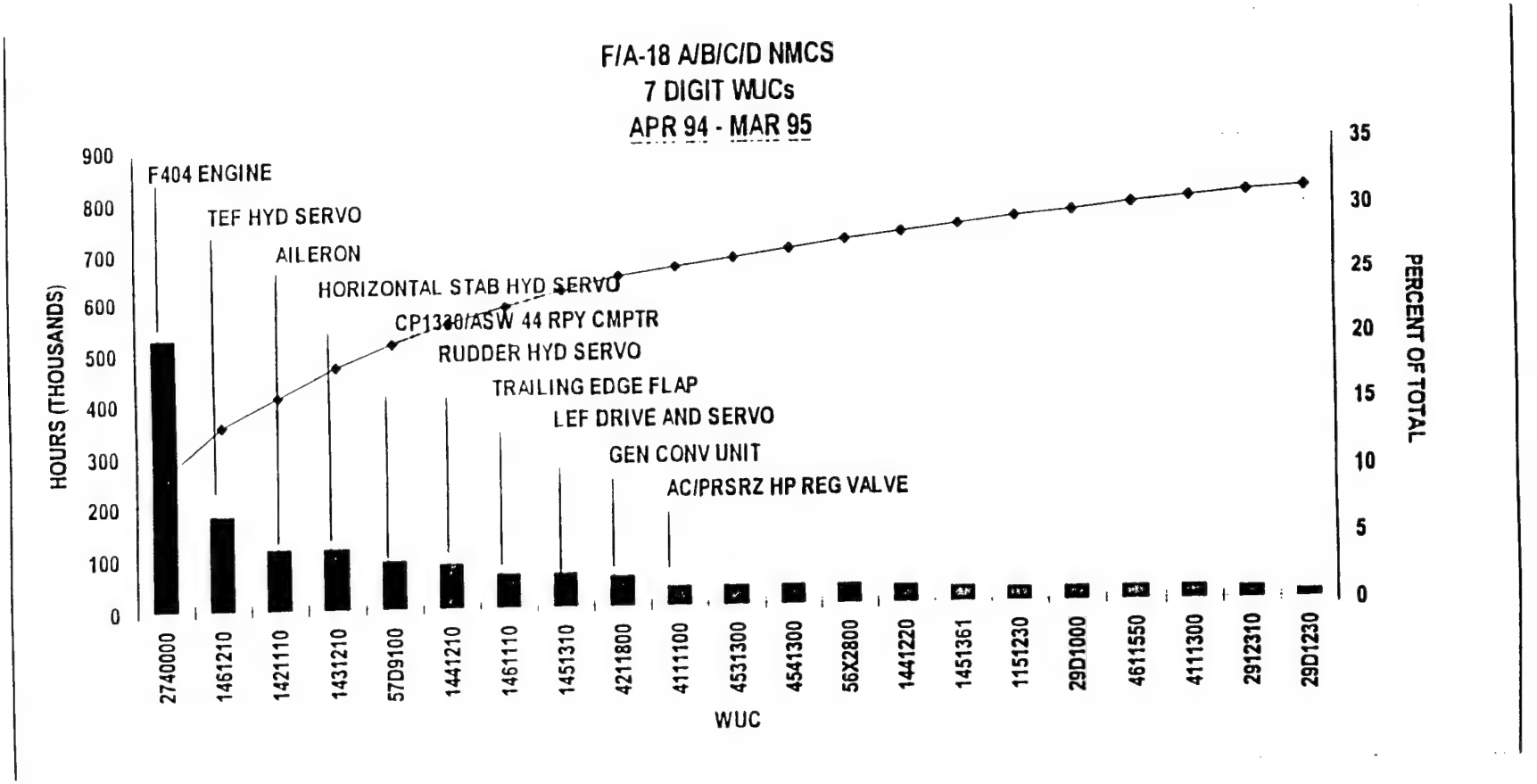
With a proposed modeling hierarchy identified and populated with candidate tools, the job of assessing the utility of such a concept remains dependent on a scenario and input system data. Since the JAST PO has identified the three aircraft (A/C) shown as comparative systems, DRC concentrated on identifying data sources for these; collecting data in support of building data base sets; and using the data in the sample analysis. The sources shown here were used in populating the baseline comparison system data base sets. It was decided to base the sample analysis on the F/A-18C. In the course of a comprehensive data search and to ensure a realistic analysis effort, DRC met with members of the Assistant Program Manager for Logistics (APML, F/A-18C) to discuss reliability and support issues.

Study Flow Rationale

- **Data Base Sets:**
  - F/A-18C, AV-8B, F-16C/D (JAST PO BCS options)

- **Data Sources:**
  - AV3M/NAVFLIRS from NAVSEALOGCEN and NALDA (Naval Aviation Logistics Data Analysis) system, F/A-18C, AV-8B
  - CAMS (Core Automated Maintenance System), F-16
  - VAMOSC (Visibility and Management Operating and Support Cost) system, both Navy and Air Force
  - Aviation Supply Office
  - Naval Air Warfare Center

This and the following chart from the F/A 18 Program Office show that the pacing items in system support for the F-18 are the engine and, in combination, the hydraulic actuator servos for the flight control systems. This was validated in comparative studies examining support data obtained from 3M sources for the operating year.


F/A-18 A/B/C/D NMCS
7 DIGIT WUCs
APR 94 - MAR 95
HOURS (THOUSANDS)
PERCENT OF TOTAL
WUC
F404 ENGINE
TEF HYD SERVO
AILERON
HORIZONTAL STAB HYD SERVO
CP1340/ASW 44 RPY CMPTR
RUDDER HYD SERVO
TRAILING EDGE FLAP
LEF DRIVE AND SERVO
GEN CONV UNIT
AC/PRSRZ HP REG VALVE
900
800
700
600
500
400
300
200
100
0
35
30
25
20
15
10
5
0
2740000
1461210
1421110
1431210
57D9100
1441210
1461110
1451310
4211800
4111100
4531300
4541300
56X2800
1441220
1451361
1151230
29D1000
4611550
4111300
2912310
29D1230

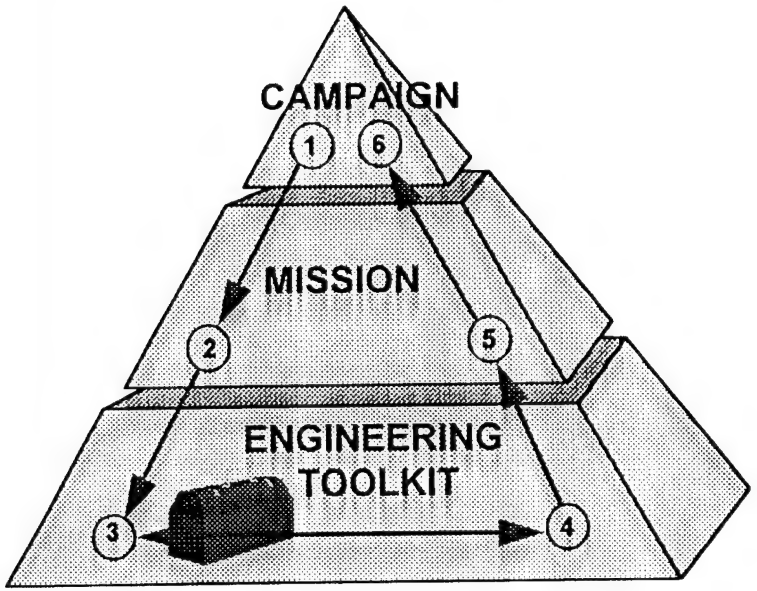
As clearly shown here, the servo systems contribution to the support load rests in design expectations not achieved in the field. We see the realized MTBFs fall far short of the design specifications and are reduced by factors ranging from 2 to 10. The stabilizer servo dominates in the shortfall and will be used in the sample analysis. Now with candidate tools identified, data collected, and a recommended modeling hierarchy established, we will walk through the JLME analysis process and conduct specific analyses on the horizontal stabilizer servo.

Optimistic Design Goals Not Achieved

COMPONENT	DESIGN MTBF	ACTUAL MTBF
TEF SERVO	*3224*	*428*
STAB SERVO	*3224*	*323*
LEF SERVO	*4518*	*2000*
AIL SERVO	*4273*	*1239*
RUD SERVO	*4500*	*1091*

The JLME design trade process vision is depicted here. In a typical trade analysis sequence, the THUNDER code is executed using the campaign scenario of interest (e.g... Southwest Asia, a return to Desert Storm). In an actual scenario there may be several different strike aircraft participating and output files may point to one aircraft type that has significantly fallen short of its required sortie generation rate. To investigate the logistic support system and isolate logistics pacing items the same OPTEMPO is fed to the mission level simulations (i.e. either LCOM or CASEE). Output at this level defines the pacing items to the 4 or 5 digit work unit code (WUC). The analytic engineering Toolkit is then used to consider get-well fixes. DRC has identified the modular modeling system (MMS) environment as an ideal mechanism for conducting these multidimensional trades since it provides the opportunity to plot a multitude of variables against each other. The MMS is an enhanced development of the Rapid Model Development Environment (ReMeDEe) which has had a successful history in the BMDO logistics community. A version of LOGAM, a logistics model operated by the US Army Space and Strategic Defense Command, has been hosted in the ReMeDE and allows rapid conduct of trade studies. As such, use of MMS in such a Toolkit, if considered in a potential BMDO effort would be a natural extension of work already done by DRC. The closed loop nature of the complete JLME process shown here allows quick validation of the get-well fixes at the campaign level and an overall self consistency check.

JLME
Design Trade Process Vision



1. Identify Aircraft Sortie Shortfalls using THUNDER Campaign Level Model

2. Evaluate Logistics Support System & Isolate Logistics Pacing Items using LCOM or CASEE

3 - 4. Perform Trade-Off Analyses & Develop Get-Well Options that Balance Affordability & Capability

5. Validate Options using LCOM; Select Best Get-Well Option

6. Validate Selected Get-Well Option at Campaign Level (THUNDER)

Trade studies that once took 3 to 4 months will now take 3 to 4 WEEKS !

The sample analysis will now be outlined using the basic assumptions shown. The combat scenario assumes a demand for 1620 sorties over the 30 day period with stress on the sortie demand over the last 23 days where 60 sorties per day are required. F-18 support and cost data are drawn from the data collected earlier in our work. The analysis begins with OPTEMPO, support and other data requirements being input into the campaign level assessment simulation THUNDER.

Major Assumptions

- Predecessor System = F/A-18C
- 20 Year Life Cycle
- Scenario Duration = 30 Days
- Sorties Planned = 1,620 (1,186 CAS + Other Missions)
- JAST Fleet Size = 2550

One of a wide menu of output reports available from THUNDER is shown here. The output identifies 100 sorties being canceled due to aircraft related problems. THUNDER, however, cannot isolate the pacing logistics items below the 2 digit WUC.

THUNDER Indicators

THUNDER Runs Show the F/A-18C Achieved "1,086" Sorties out of "1,186" Required

Sortie Summary Report By Type Aircraft

TYPE AIRCRAFT	MISSION	PLAN	SORTIES CANCELED DUE TO				FLOWN	AT TGT	RETURN
			AC	Ammo	POL	RWYS			
F-18C	CAS	1186	100						

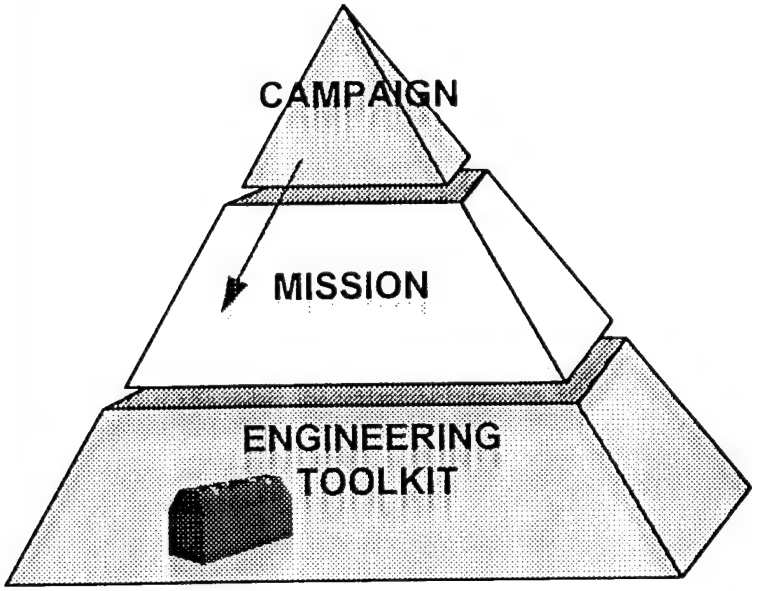
Note: Sortie Requirement and Capability based on Unclassified OPTEMPO data

Stand-alone THUNDER runs point to potential problems only...

THUNDER cannot isolate logistics constraints

Running LCOM next, however, isolates the pacing items by WUC to the 5 digit level and we concentrate on these items for our get well analysis. Within the integrated environment, with the flow of data from THUNDER down into LCOM, we expect to a realize run time savings of 2-10 days per run.

LCOM Focuses to Pacing Items



- Run LCOM with Consistent 30 day OPTEMPO Data
  - Flying Schedule
  - Sortie Rates
  - Sortie Duration
- Validate THUNDER
- Isolate Pacing Items by WUC within LCOM (5 digit)

Potential for QUANTUM LEAP in Efficiency.... Integrated Models and data flow from THUNDER to LCOM could save 2-10 days per run !

This chart shows the top 12 logistics drivers and their 5 digit WUC. As discussed earlier, the sample analysis will concentrate on the hydraulic servo systems with special emphasis on the stabilizer control.

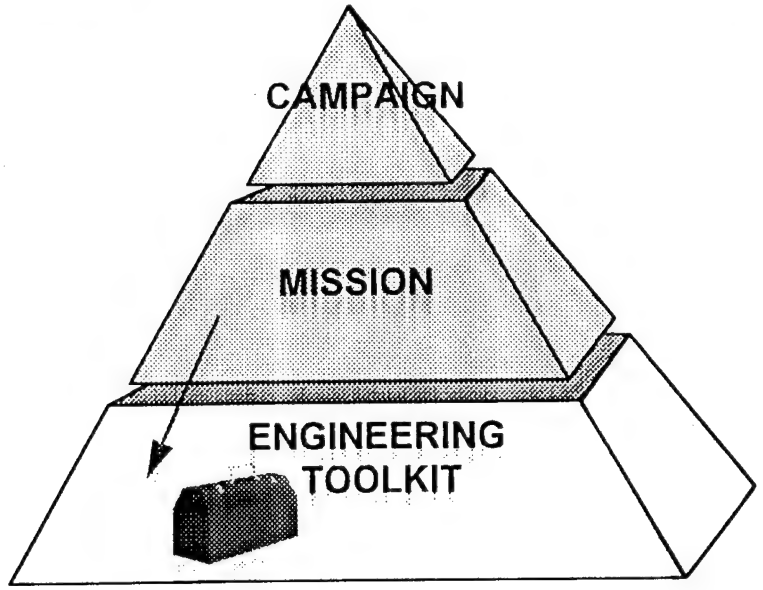
Top 12 High Driver NMC WUCs for F/A-18C

27400	GE 404 Engine
14312	Stabilizer Control (Hydr Servo Cyl)
14612	TE Flap Control (Hydr Servo Cyl)
14412	Rudder Control (Hydr Servo Cyl)
14212	Aileron Control Installation (Hydr Servo Cyl)
14513	LE Flap Drive Installation (Servo-Valve)
57D91	Roll-Pitch Yaw Computer
742G1	APG-65 Radar Transmitter
742G6	APG-65 Antenna
74681	Digital Display Indicator
742G2	APG-65 Receiver Exciter
74D93	AAS38 Detecting Set (IR Rcvr)

JLME will allow easy isolation of pacing items that have greatest potential for return on investment

Finally, with consistent OPTEMPO and support data flowing into the candidate MMS environment in the Toolkit, specific trade analyses can be done on the pacing items to identify potential get-well design and or support changes. Again the analytic nature of these tools allows for great flexibility and speed in completing a wide variety of trade studies and assessing cost and performance benefits.

Deterministic Toolkit Model Trades Allow Rapid "Get-Well" Analyses



- Conduct "Get-Well" Analyses in ToolKit:
  - Identified Pacing WUCs
  - OPTEMPO
  - Rate of Maint Actions
  - Task Times
  - Task Probabilities
  - Stock Level
  - Supply Times

- Trade-Offs within ToolKit:
  - Life Cycle Cost (LCC) Analysis
  - Level of Repair Analysis (LORA)
  - Reliability & Maintainability (R&M) Analysis
  - Sustainability (Sortie Generation) Assessments

Historically, engineering analyses have been stove-piped;

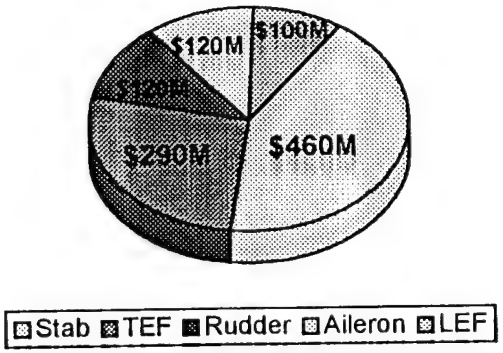
With JLME, analyses will be fully integrated, ensuring consistent and valid results!

For the case study considered here, we see sample output data available from the Toolkit resources. The 20 year O&S cost data presented is from NRLA and the sortie capability graph is an output of Mini Dyna-METRIC. The lower chart presents the "as is" repair level distribution data used in the NRLA calculations of O&S costs.

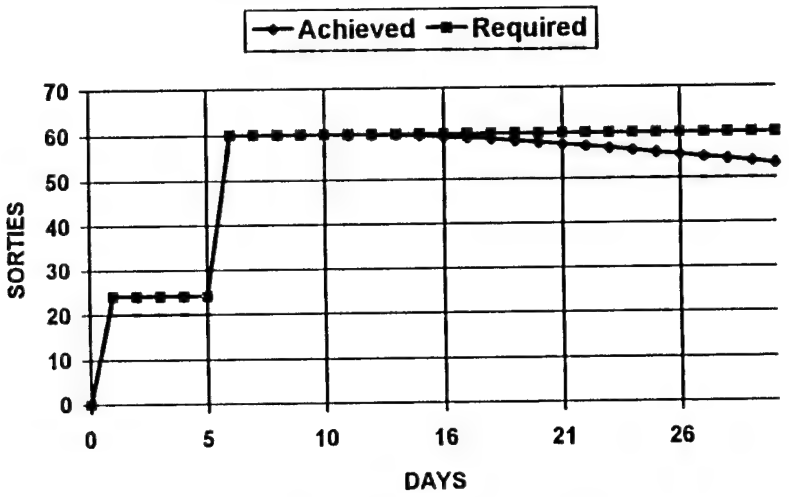
F/A-18 Baseline

5 Servos 20 Year O&S Cost/Level of Repair/Sortie Capability

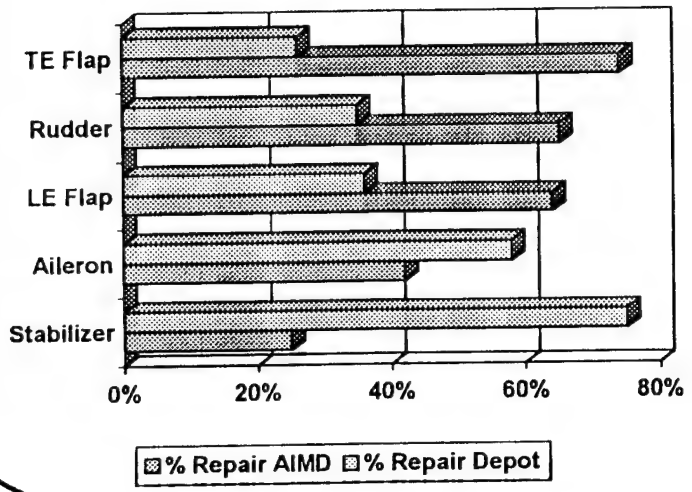
20 Yr O&S LCC



Sortie Capability (Mini Dyna-METRIC)



Maintenance Concept



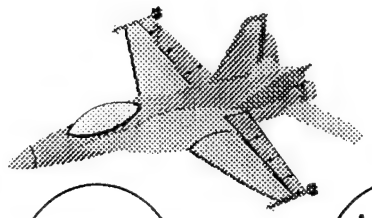
JLME will allow for rapid benchmarking and analyses
- Life Cycle Cost
- Level of Repair
- Sortie Capability

through NRLA, JOSTE & Mini Dyna-METRIC

While engines were identified as the top driver for non mission capable rates, the hydraulic flight control servos, in sum, exceed the engine in contributing to the down time. In addition, since the engine is considered government furnished equipment, it would be reasonable for a WSC to concentrate on the next design/support problem area. Therefore, considering the servos, this chart outlines the get-well approach. Option 1 would be to use the same basic servo but take advantage of evolving diagnostic technologies and reassess the support concept by running NRLA in the optimization mode. TRW has identified the potential to reduce cannot duplicate rates by 50% for servo systems using new diagnostics technology. This effect along with determining an optimized level of repair will lead to increasing the mean time between demands and provide for both an increased sortie rate and lower O&S costs. Option 2 would be to pursue an entirely new servo design where increased reliability could be purchased.

The next chart presents a summary of the analyses conducted within the Toolkit using NRLA and Mini Dyna-METRIC. The enhancements shown are based on the horizontal stabilizer analysis alone.

Sample "Get-Well" Approach



THUNDER

LCOM
14XXX

Isolate Pacing Subsystem

TOOLKIT
5 WRAs

Identify Candidate WUCs
Baseline Cost,
Repair Level,
Sortie Generation

KEEP EXISTING SERVOs
- Recompute Repair Level
- Built in Diagnostics

Option 1
- LCC
- Sortie Generation

Compare Options
- Affordability
- Sortie Generation

NEW SERVO DESIGN
- Increased Reliability

Option 2
- LCC
- Sortie Generation

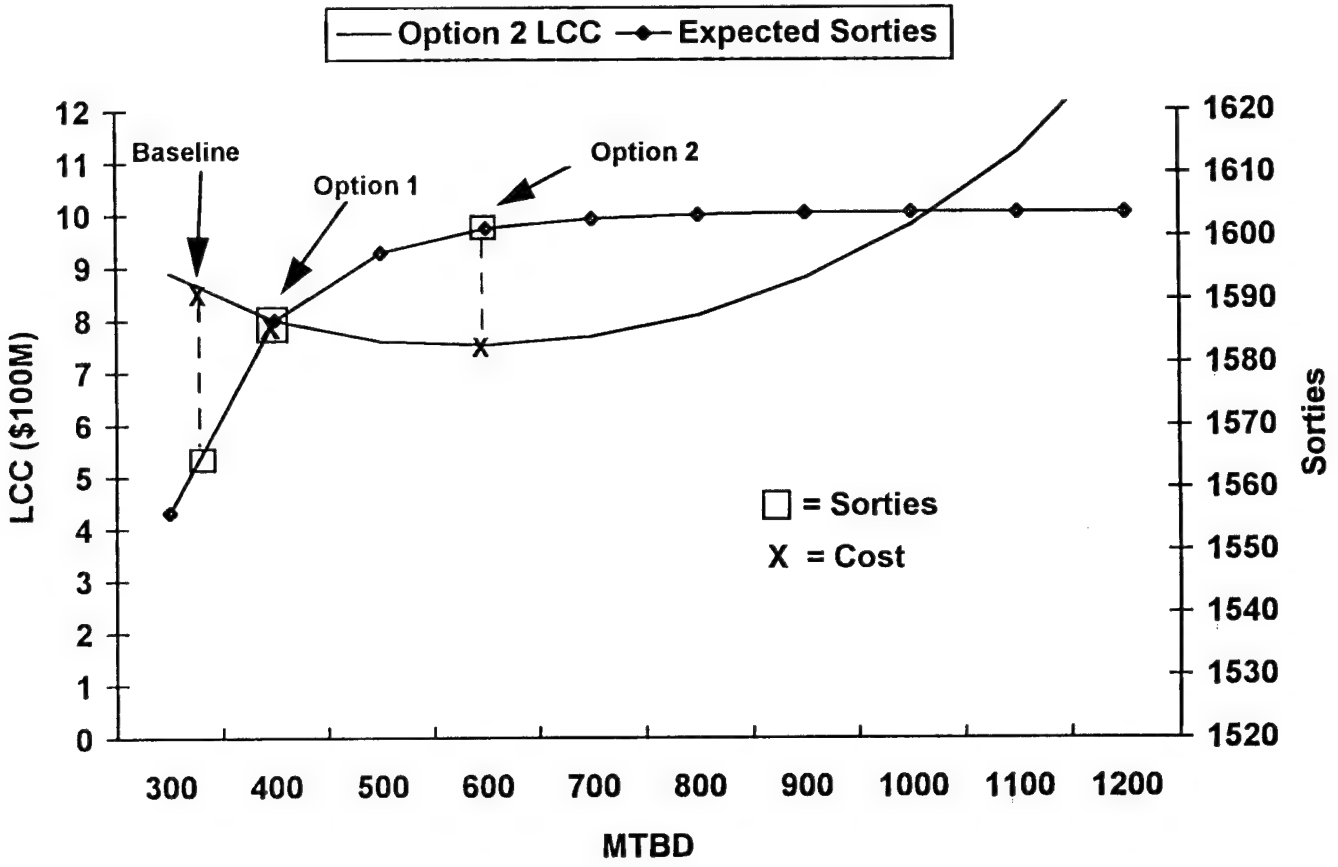
HYPOTHESES:

- Lower O & S Costs
- Higher Sortie Rate
- Fewer Spares, Smaller Mobility Footprint

Based on the results presented here, Option 2 would be the preferred approach since it offers both the highest level in expected sortie generation rate and the lowest life cycle cost. But one could argue that there is risk associated with the new design. After all, the servos bought in the previous procurement failed to meet their design reliability by a factor of up to ten. While this is a legitimate concern, the ability to use the MMS and conduct the multitude of trades involved to construct this summary chart can also be used to help structure a warranty and incentives program to protect the acquisition process. As seen on this chart, for example, if the government negotiated to buy the 600 MTBF servo, the Mini Dyna-Metric and NRLA trades in combination with JOSTE (cost) could be used to quickly calculate the dollar losses associated with a servo operating at a lower MTBF. Thus, these cost factors could be factored into a warranty and incentive program such that a contractor faces penalties on the one hand if he fails to meet specifications or he is awarded bonuses on the other hand if performance in the field exceeds specifications.

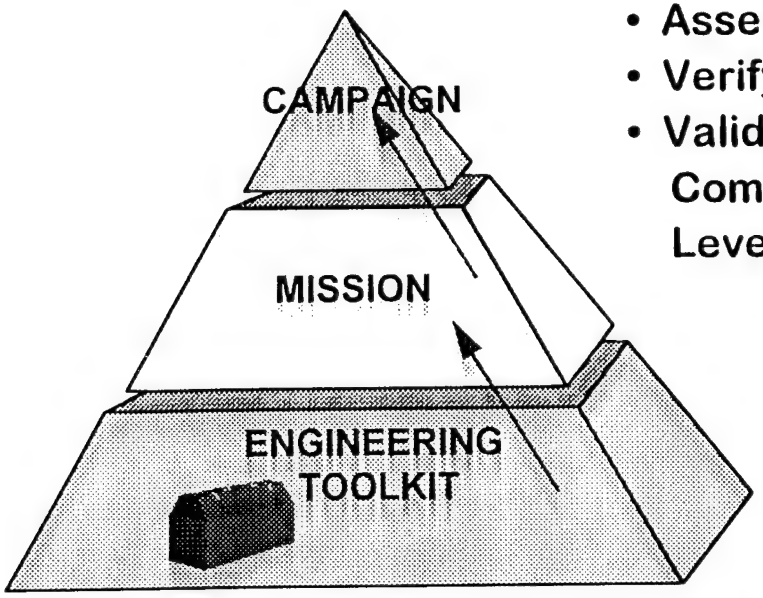
F/A-18C Servos

Trade Analysis Summary - Recommend Option 2



What ever get-well solution is adopted, the fix is passed up to LCOM and on to THUNDER where the codes are re-executed to validate enhanced battle outcome, sortie rate generation and support performance as well as to provide an internal self consistency assessment

Re-execute Mission/Campaign Level Scenarios with "Get-Well" Fixes

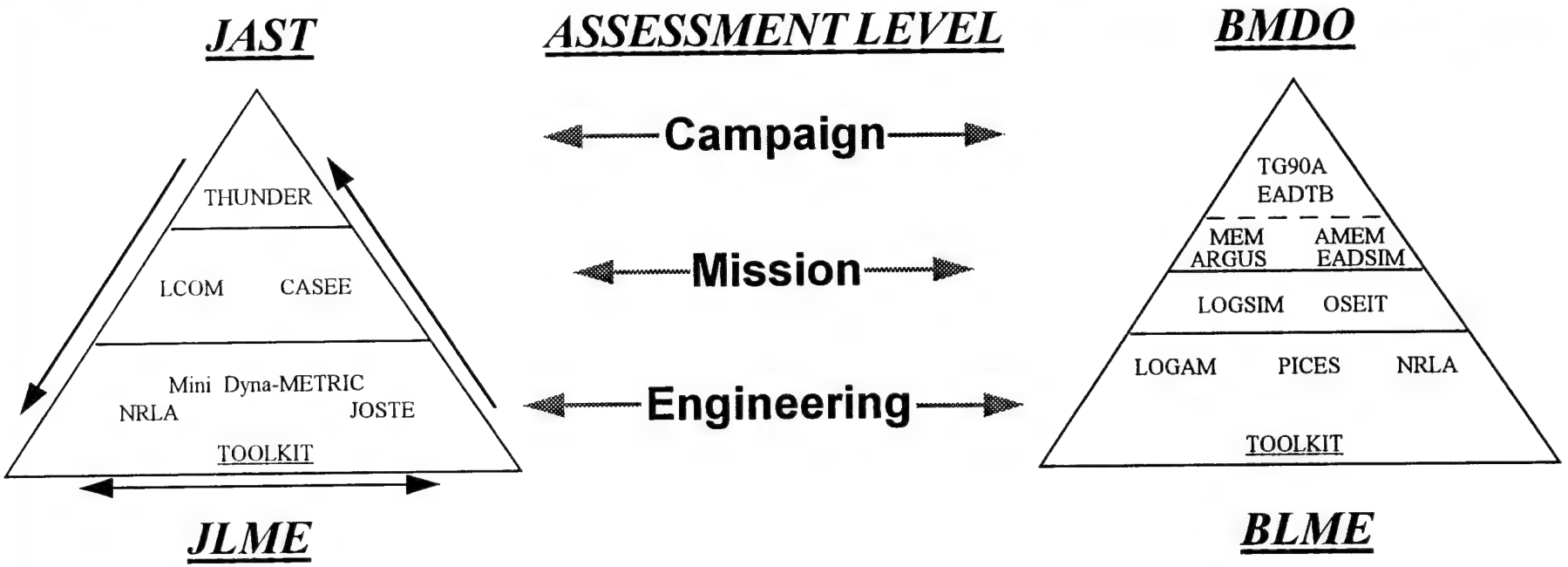


- Assess Wargame Outcome Improvements
- Verify Mission Performance Enhancement
- Validate Self Consistency of JLME Process by Comparing Sortie Generation Rates at all Three Levels

JLME allows for immediate cross-feed of R&M parameters for fast validation of get-well options !

The modeling environment concept and the corresponding design trades and get-well analysis process using such a framework just described are directly usable by BMDO. The integration of tools within the hierarchy and across the Toolkit can be applied to a conceptual BMDO Logistics Modeling Environment (BLME) and can be used to automate and accelerate the transfer of information between various BMDO campaign, mission, and engineering level models and simulations. The Toolkit, with analytic models, can be used to perform a wide range of trade studies & get-well analyses rapidly. Results of studies at this level will help define a bounded set of favorable concepts to be examined at the mission level and will, provide a guide to the most effective use of these complex/detailed, discrete event simulation models found at the mission and campaign levels. Replacing the JAST models with the proper mix of BMDO sanctioned models (e.g. leveraging work conducted in support of the NTB analytical toolbox) would be a first step in defining a conceptual BLME.

Relationship of JLME to BMDO Logistics



- JLME Concepts Directly Usable by BMDO
  - Integrated model hierarchy will facilitate data transfer and model use
  - Toolkit of analytical/engineering models to rapidly perform trades and get-well analyses
- Can be Adapted to Define a BMD Logistics Modeling Environment (BLME)

The concept, in principal, of the JLME reflects many of the strategies, initiatives, and areas of applied logistics work supported within BMDO. The synergy between a JLME & BLME has also been identified. This chart briefly summarizes the benefits potentially available to BMDO. First, the JLME element would be of important and immediate relevance without modification to BMDO in the area of Theater Missile Defense. Within TMD, the four pillars (active defense, passive defense, attack operations, and C3I) combine in a synergism to help define proposed architectures. While much work has been done on active defense and C3I, and some effort in passive defense, it is not clear to what extent, combined force scenarios have leveraged or handled aircraft in an attack operations role. Such analysis could now be included in a more integrated way and would help identify the relief of stress on both TMD asset size and support requirements. In addition, Congress has renewed interest in the potential fielding of UOES and or dem/val type systems in both the TMD and NMD arena. A BLME framework could be used to identify optimum support concepts for evolving systems. For TMD systems, support could very well be scenario dependent and the BLME could be used to address optimum support strategies for various threat scenarios. Also, monitoring reliability growth as designs mature during the technology readiness research stage could allow trade studies that support, with increased fidelity, acquisition strategy decisions. As mentioned earlier, incentive and warranty programs could be more confidently quantified through use of such an analysis system. Clearly, though, the JLME/BLME concept as outlined here is not the full story, for deployability, the third leg in a logistics modeling environment composed of JLME and BLME is needed to complete the total picture.

Benefits of a "BLME" to BMD Logistics

- **Immediate & Direct Relevance to TMD Design**
- **A Complementary BMDO Logistics Modeling Environment (BLME) Can**
  - **Leverage current JLME initiative work**
  - **Utilize past work in support of BMDO**
  - **Provide a fast and flexible logistics assessment tool**
    - Identify support options for a deployed UOES
    - Evaluate reliability growth in evolving technologies
    - Identify optimized support for potential fielding of NMD technologies and mature system design
    - Help quantify warranty/incentive strategies
    - Enhance COEA, ORD development
- **Consistent with NTB Strategies & Goals**
- **Imbeds Logistics into Wargaming**

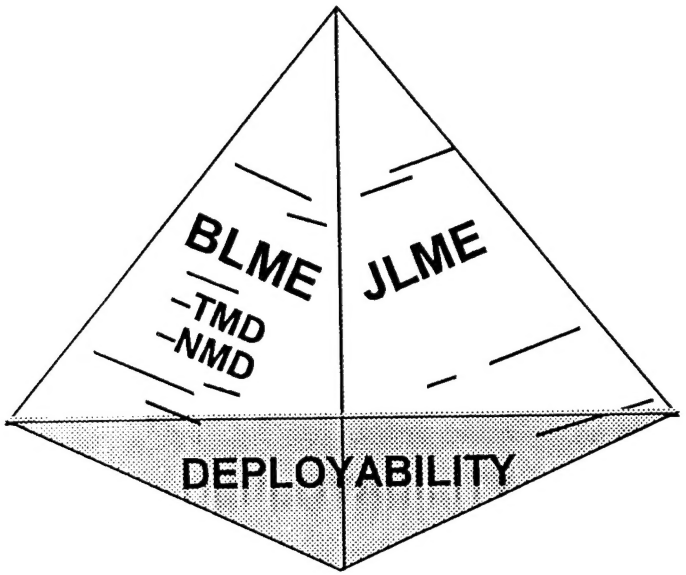
but...

- **"Deployability" is Needed & is Mutually Applicable (JAST/BMDO)**

This chart depicts the linkage between deployability, an area scheduled for consideration in a planned follow-on JLME phase II effort, and complementary BLME/JLME modeling frameworks. With the addition of deployability, the picture is complete and the foundation in place to ensure complete and comprehensive assessment across the full span (deployment, employment, support) of weapon system operations.

Deployability: Completing the Picture

- **A Deployability Capability in JLME/BLME Completes the Triad of Tools for Logistics Support**



- **Comprehensive Assessment**
- **Mutually Applicable to JAST & BMDO**
  - **Focus of JLME II follow-on effort is deployability**

In Summary, the concept of a logistics modeling environment has been presented and its utility demonstrated through the sample analysis. The JLME concept ensures the integration of logistics factors into wargaming, is directly translatable to a BLME concept and can offer a significant contribution to fielding affordable and supportable BMD systems.

Summary

- **Presented and Reviewed a Framework for an Integrated Logistics Modeling Environment**
- **Assessed Functionality/Utility of the Concept**
- **Have Shown Relevance of JLME to BMDO Logistics and NTB Efforts**
- **Identified Benefits of a BLME to BMDO**